



Results from Air Force Investigation into 20mm Case Neck Separation

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Presentation Outline

- 20mm Case Neck Separation (CNS)
Description/Background
- Air Force Screening Operation
- Results/Path Forward
- Conclusions

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CNS Failure Description



- Tensile failure of M103 brass case in shoulder-neck region during firing
- Excessive loading stretches neck to failure
- Propagates around circumference of neck



CNS Background

- 40-plus year history affecting all Services
- No root cause consensus
- Crimp groove most likely failure source
- Groove still present post-firing
- Projectile pulling case neck



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CNS Progression



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Gun System Damage

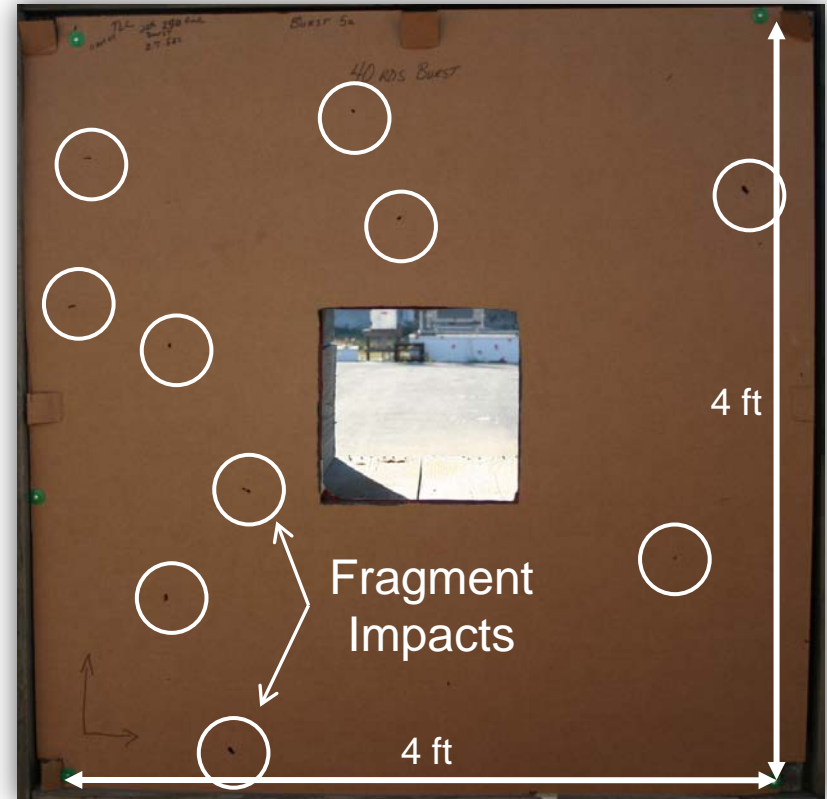
- Jams gun due to lack of case control
- “Soft” jam upon ammo download
- “Hard” jam with gun at max firing rate



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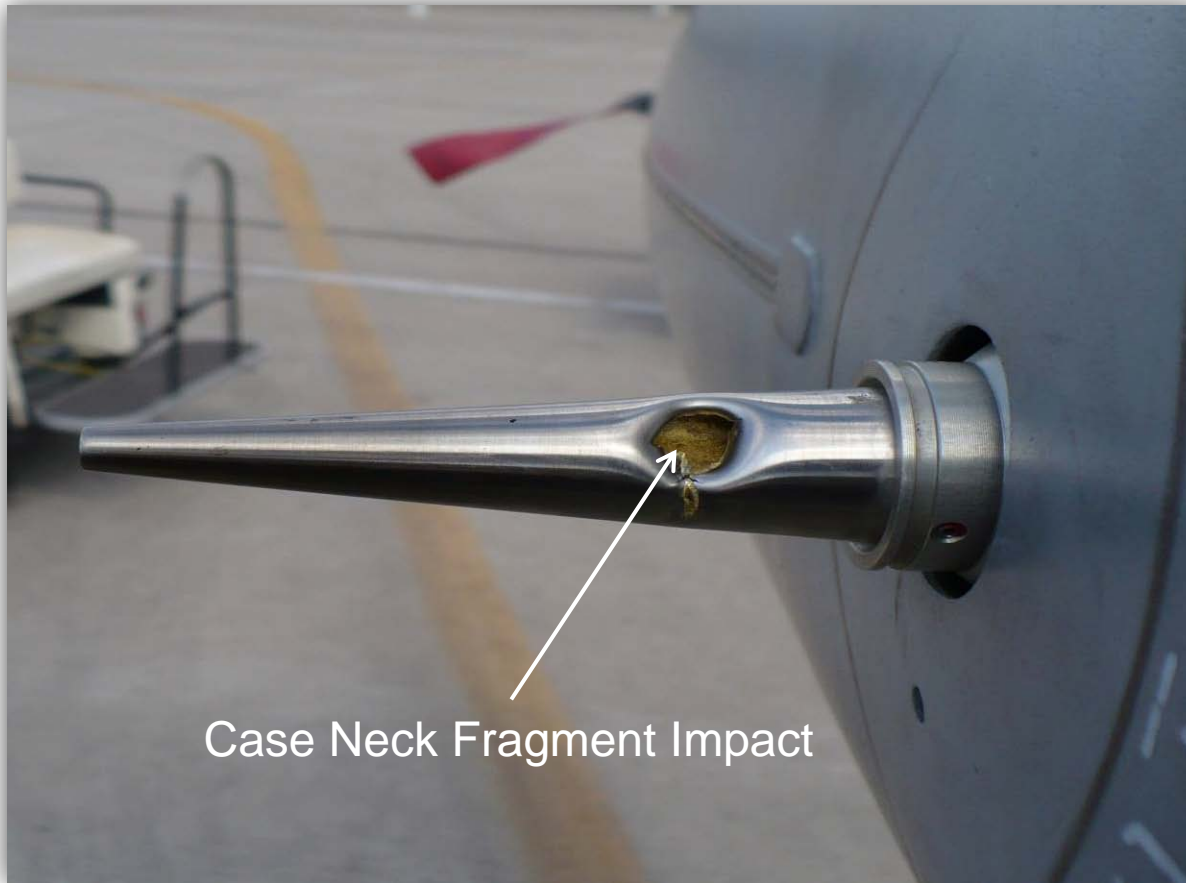
CNS Fragmentation



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F-16 AoA Probe Damage



Case Neck Fragment Impact

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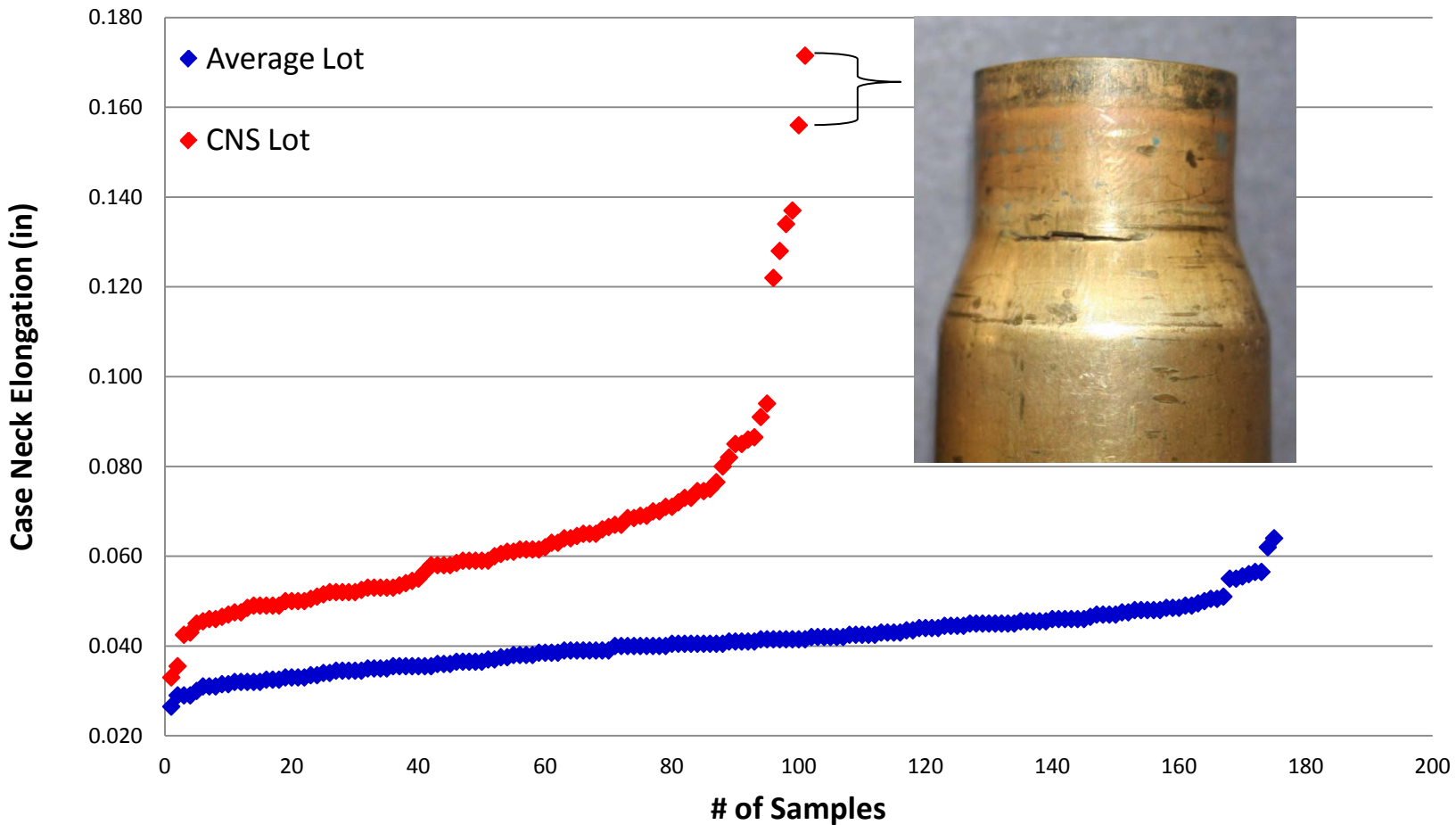
Air Force Screening Operation

- Tasked to assess CNS potential in inventory
- Screen via case neck elongation measurement
 - Hypothesis – CNS-prone ammo elongates more
- ~ 200 lots subjected to projectile extraction, single shot and M61A1 burst firing
- Brass from all three tests measured
- 6 lots experienced CNS during test
- Lots assigned risk level 1-4

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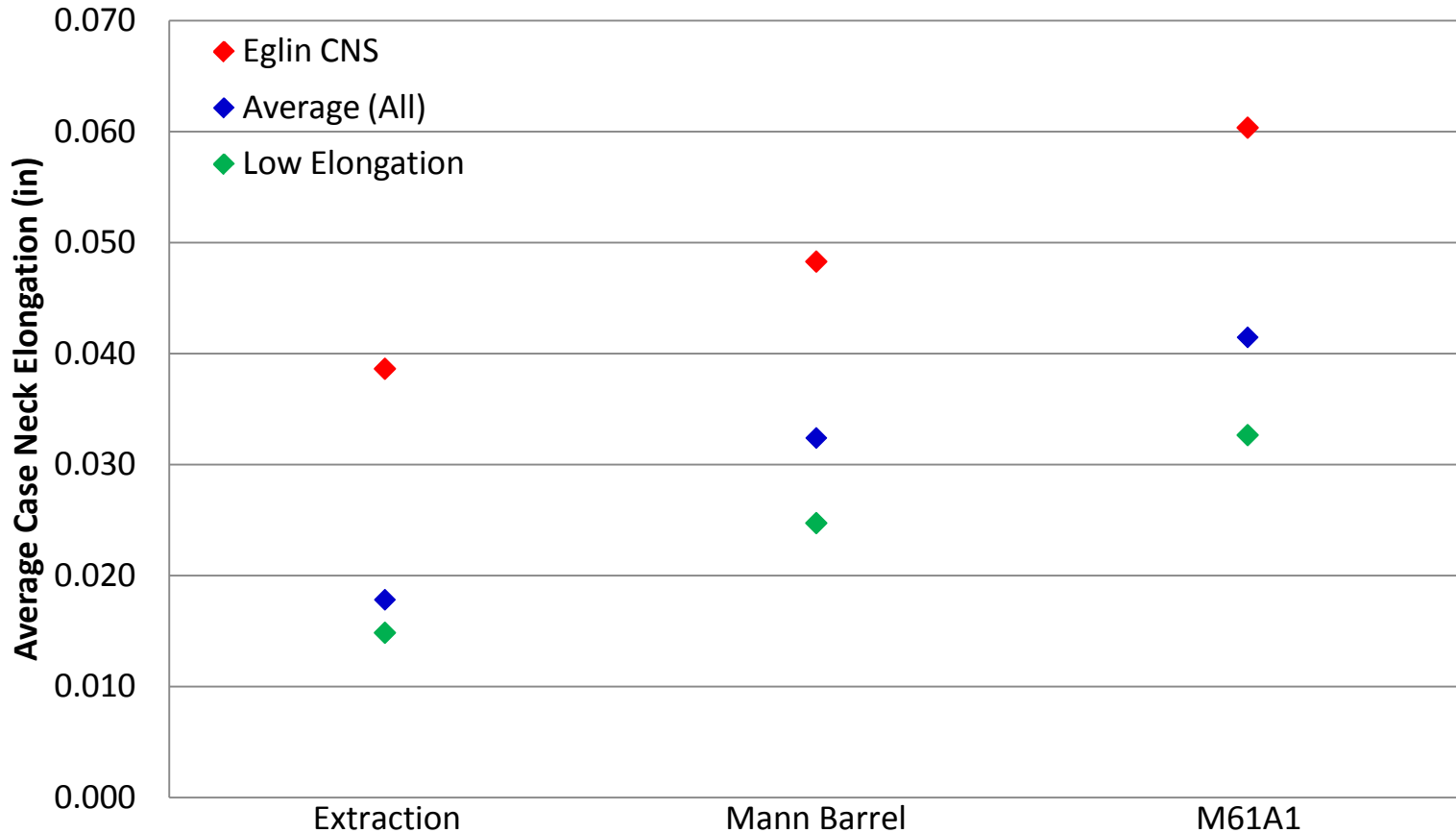
M61A1 Elongation Profile



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Elongation vs Test Type



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Elongation/Extraction Force Comparison



Category	Avg M61A1 Elongation (in)	Max Extraction Force (lbs)	Avg Extraction Force (lbs)	Range (lbs)	Std Dev (lbs)
Eglin CNS Lots (6)	0.0603	2460	1932	1172	299
Average - All Lots (200)	0.0415	2021	1633	716	178
Low Elongation (5)	0.0320	1415	1179	359	99

Allowable Range: 1100-2800 pounds

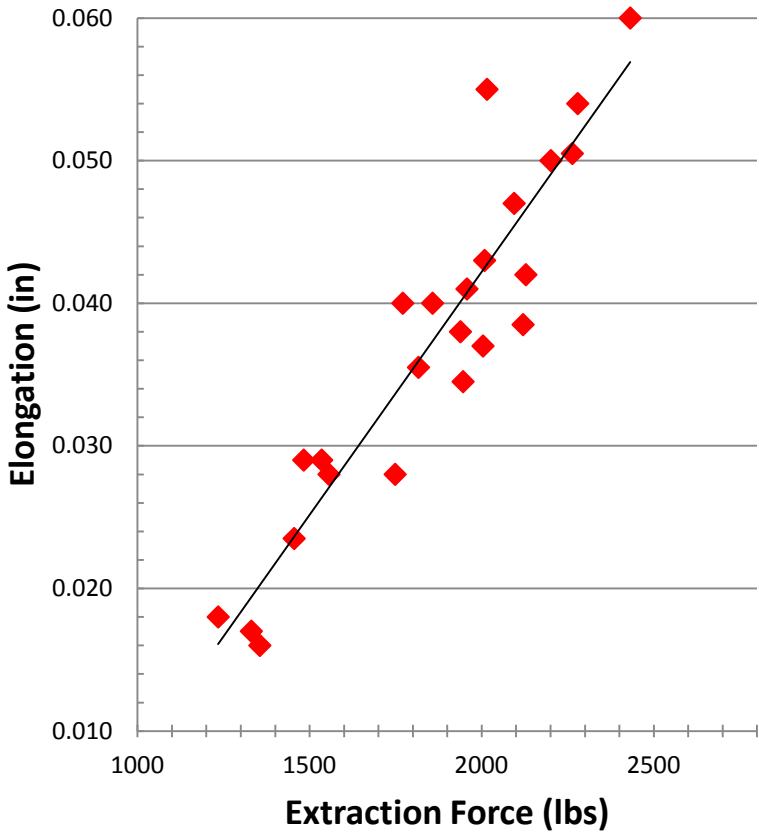
- ~80% of 145+ historical CNS lots w/ max extraction force greater than 2000 lbs
- Sample average 2260 pounds

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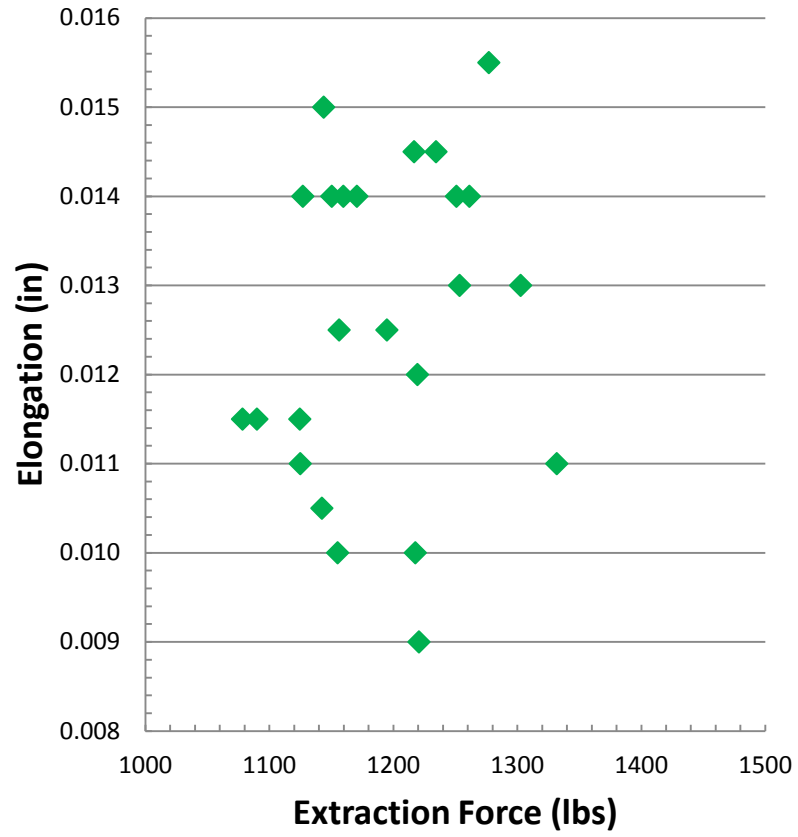


Elongation vs Extraction Force

Lot -069



Lot -092

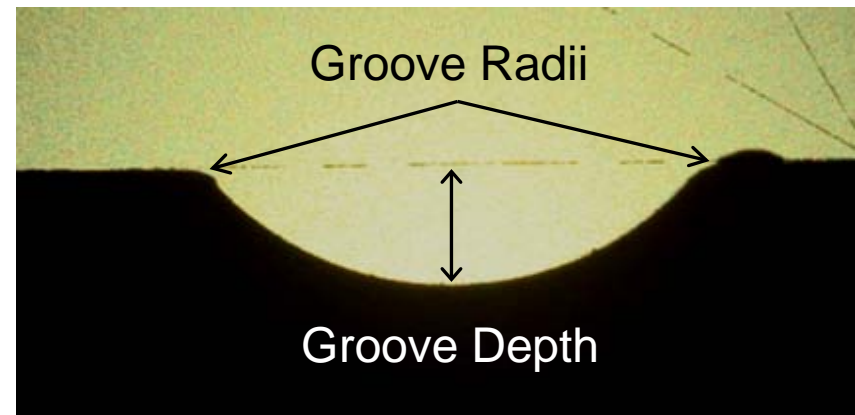


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20mm Cartridge Modifications

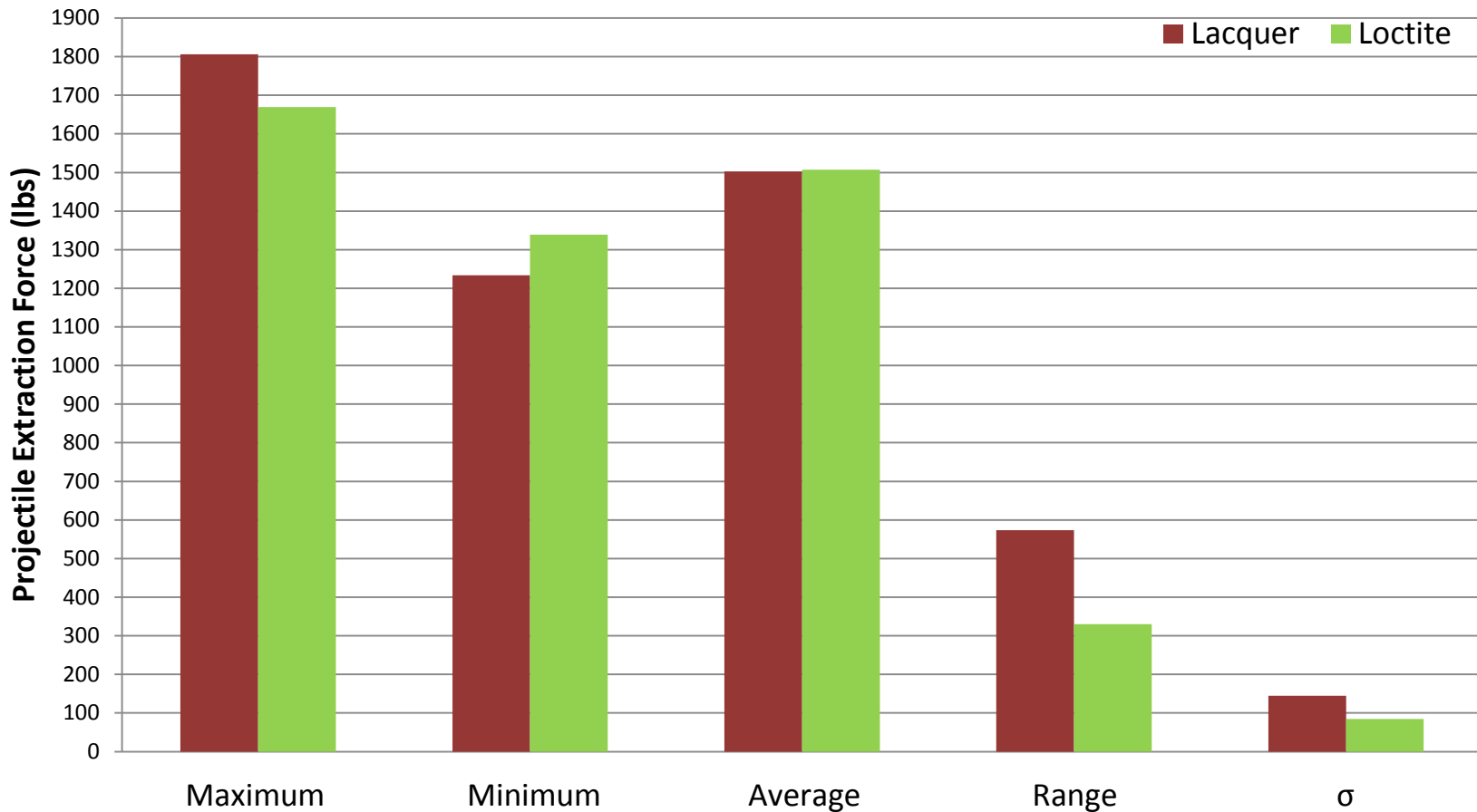
- Loctite sealant (2010)
 - Reduced extraction force variance
- Modified crimp groove (2012)
 - Shallower groove depth, less sharp radii
- Reduce 2800 lb upper limit – TBD



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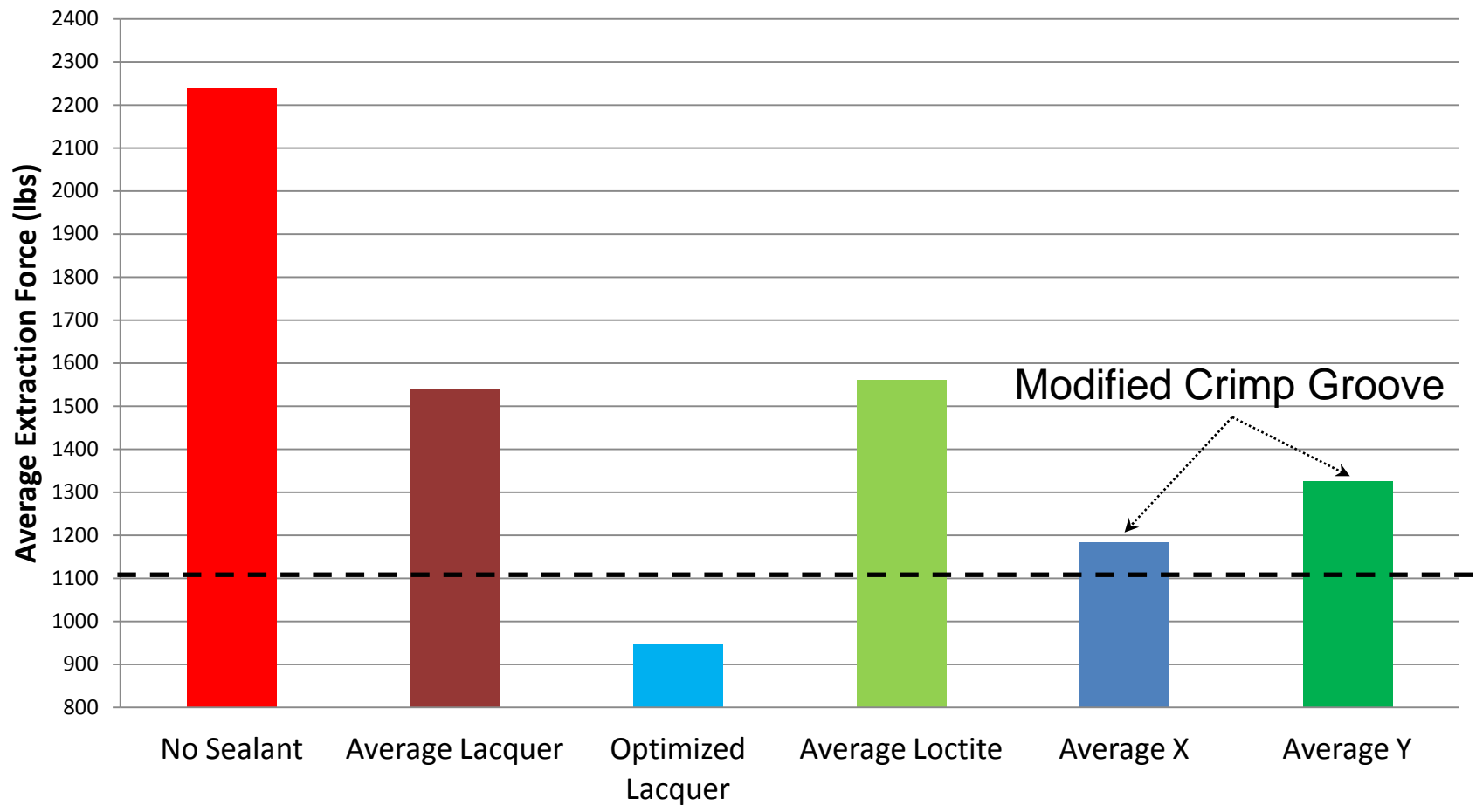
Extraction Force vs Sealant



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Extraction Force vs "Configuration"



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Conclusions

- CNS lots elongate more than average lots
- Elongation correlated with extraction force
- Higher extraction forces present in majority of historical CNS lots
- Loctite/crimp groove modifications promising



Questions/Comments??



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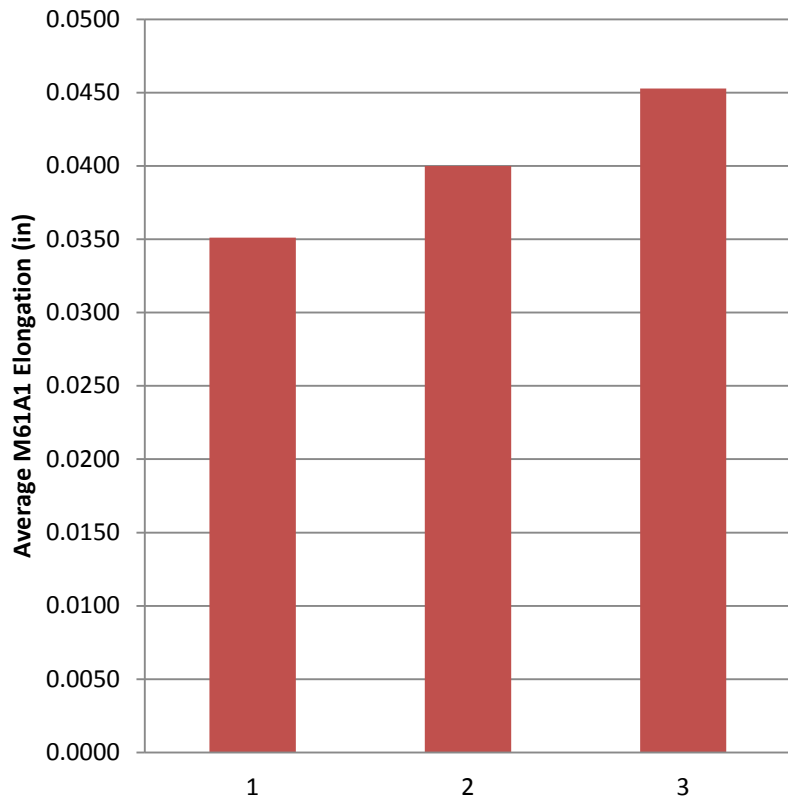
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Backup Slides

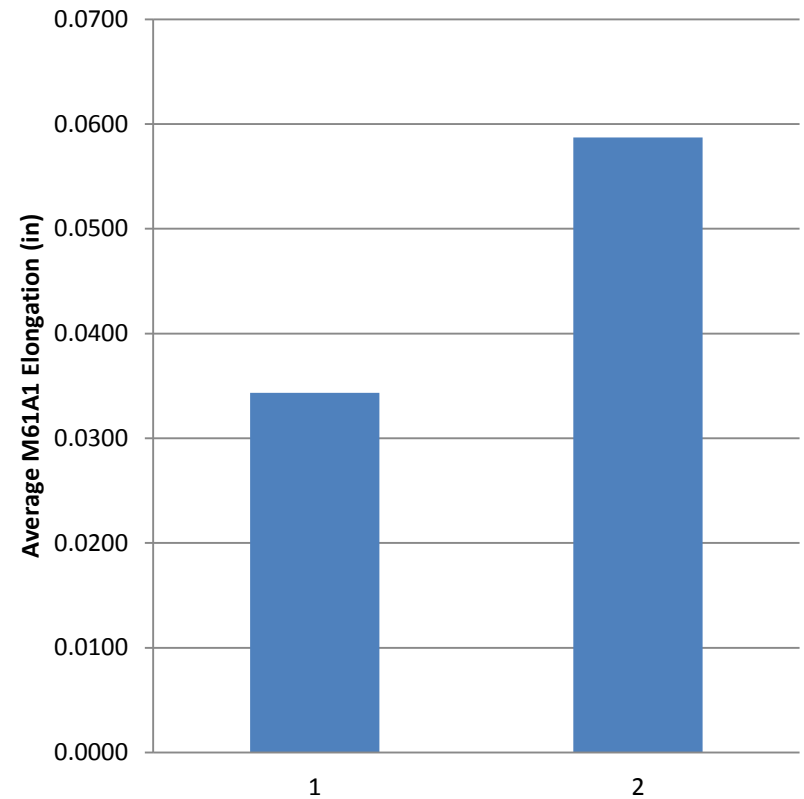


Elongation vs Sample

Lot -086



Lot -039

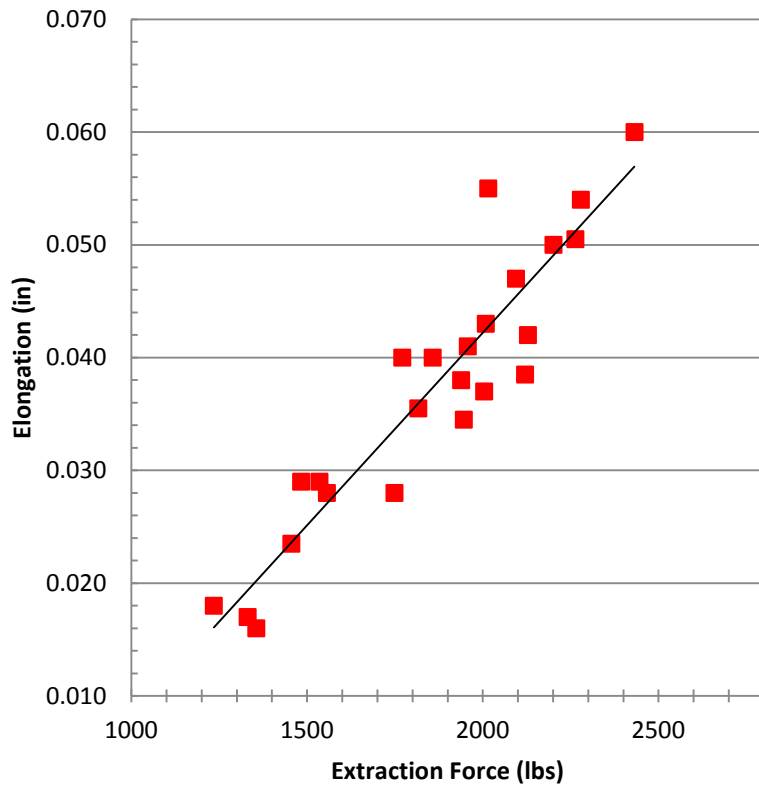


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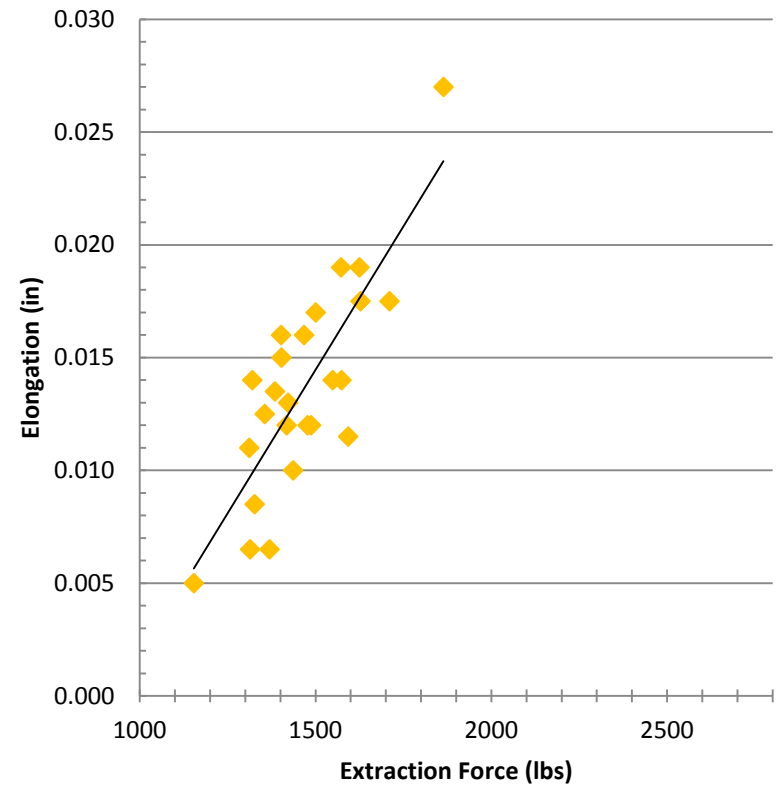


Elongation vs Extraction Force

Lot -069



Lot -002 (Loctite)



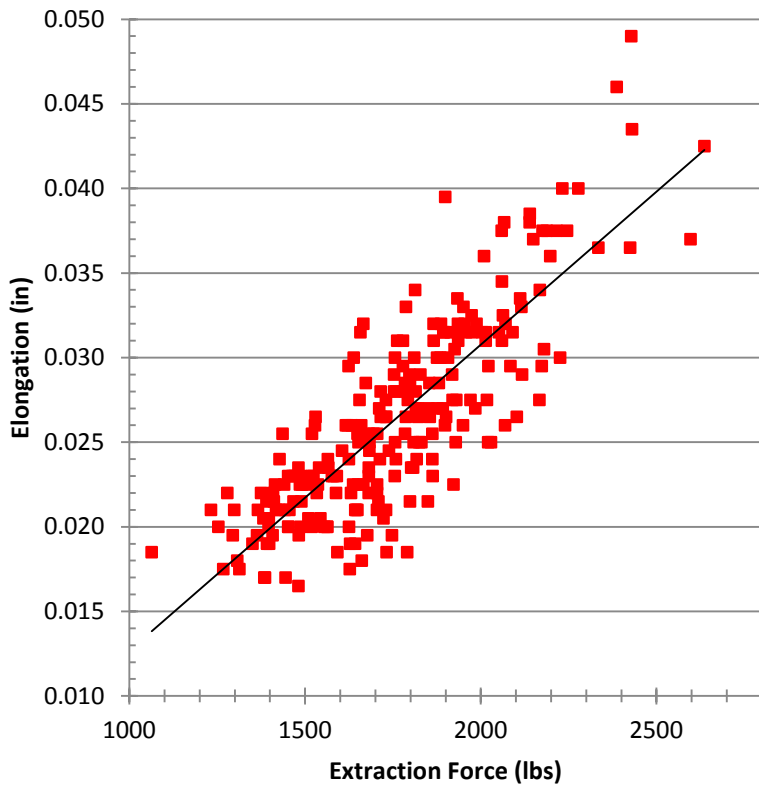
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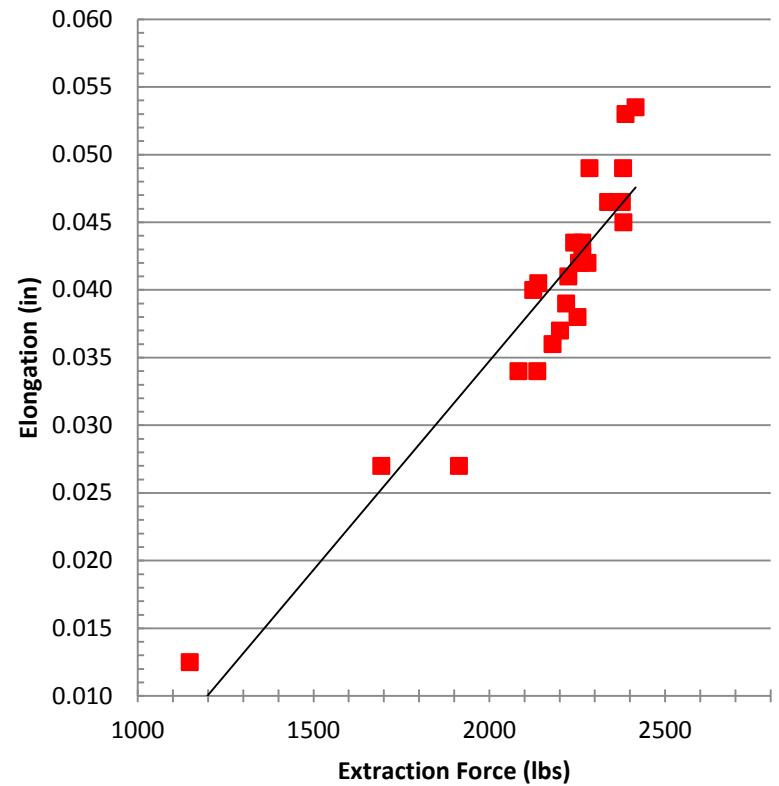
Elongation vs Extraction Force



Lot -030



Lot -066



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Secondary CNS



- Result of primary failure
- Partial telescoping of advancing cartridge
- Smoother, mid-shoulder fracture surface
- No “dimpling”

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